Tutorial on Importing Spatial Data into LandView® 5

The LandView 5 DVD product contains 36 different layers of spatial data derived from databases at the Census Bureau, EPA, and USGS. However, users often have a need to add their own spatial data layers to be used in conjunction with those already provided. The LandView 5 software allows the user to add up to five new spatial data layers with no programming or additional software required. The source of these new layers can be something as simple as a three-column spreadsheet, where each row represents a map point and contains a latitude, longitude, and a name. For more involved spatial data types such as lines (e.g., roads) or polygons (e.g., county boundaries), LandView 5 includes a utility program for converting spatial data in the form of Shapefiles into a format that can be imported into LandView 5's mapping module called MARPLOT (developed by NOAA).

Sources of Spatial Data

There are many sources of spatial data on the Web, including the Spatial Data Clearinghouse provided by the federal Geographic Data Committee (www.fgdc.gov). Another excellent source of a wide variety of spatial data is the National Atlas Website, developed and maintained by the USGS (www.nationalatlas.gov). This site provides a convenient means of examining the metadata associated with each spatial data layer and, if desired, downloading those data in several different formats.

Importing "Point Data" to LandView 5

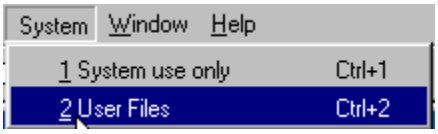
The simplest type of spatial data is point data. A layer of this type consists of a series of points, each defined by a latitude, longitude and a name. For the purposes of this tutorial, we will use a map layer from the USGS National Atlas called the ***Significant and Historic Earthquakes.*** We will use this easily downloaded data and step through the process of importing it into LandView 5 to form a new data layer and a corresponding data file, both of which can be search and manipulated.

Begin by downloading the ***Significant and Historic Earthquakes*** map layer in Shapefile format. This will result in a file named "quksigx020.tar.gz" on your hard disk. Using one of the standard compression utilities (e.g., WinZip, PKZip, etc.), uncompress this file into an intermediate file named "quksigx020.tar." Using the utility software once again, uncompress this intermediate file into the four final files for this map layer, three of which ("quksigx020.dbf," "quksigx020.shp," and "quksigx020.shx.") comprise the Shapefile format. A fourth file, "quksigx020.txt," will also be created that contains the metadata for this layer.

The LandView 5 User Files

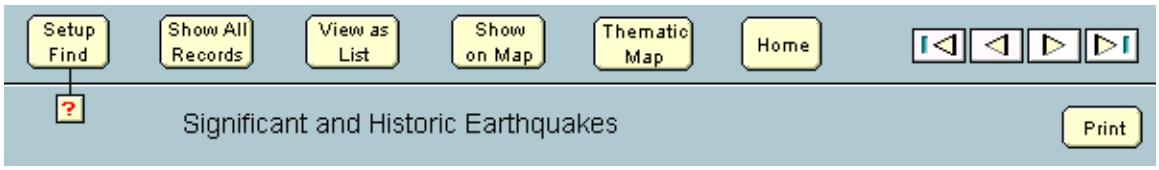
The LandView 5 software provides five separate "generic" data files for importing new spatial data records. Once imported, the display of the records in any of these files can be customized to reflect field names that are appropriate for the imported data. The software also allows the user to create map layers from these files and automatically links the objects in these map layers to their corresponding records in the data files. These new map layers can be displayed and manipulated, just as with the 36 other data layers that come "prepackaged" with LandView 5.

To access the user files, startup LandView 5 and click on the "System" menu and then select the "User Files" option, as follows:



You will be presented with a window displaying the five LandView 5 User Files ("File_01.lv5," "File_02.lv5,"…"File_05.lv5") with an "Open" button adjacent to each one. Before opening a user file, click on the "Help" button to display several help screens that summarize functions that will be performed in this tutorial. After browsing these help screens, click on the "Return to User Files" button.

To display the data layout for "File_01.lv5," click on the "Open" button to the right of this file. This will display the generic data layout for "File_01.lv5" that we will soon customize to reflect the actual data that we will be importing, in this case occurrences of significant and historic earthquakes. To begin the customization, click on the LandView 5 "System" menu and then select the second option named "Customize this file." This will bring up a display screen where the file and field information for "File_01.lv5" can be changed. Change the value in the top field labeled "File Description" from its default value of "File_01.lv5 Description" to the value "Significant and Historic Earthquakes." Now click on the "Return to User File" button in the top right corner to see the effect of this change. Notice that the title at the top of the data layout for "File_01.lv5" now reads "Significant and Historic Earthquakes" as shown below. We will customize other parts of this data layout a bit later.



Metadata

It would be useful at this point to examine the metadata file ("quksigx020.txt") that provides "data about the data" that we are going to use in our exercise. Not only is a wealth of background information provided (e.g., this database reflects historic earthquakes in the U.S., Canada and Mexico), but the metadata also contains detailed information about the specific data fields within the database. For example, in the "Entity and Attribute Information" section of the metadata, we can see that the STATE and LOCATION fields are "text" fields, while the other fields such as latitude, longitude, depth, etc., are all numeric. Note that the field named "YEAR" is actually a date field and might warrant a little different treatment than the other numeric fields. As you can see, metadata is extremely useful in understanding what a database is all about and how the specific information in that database can be utilized.

Examining the Data

Before we actually import the data records that we have downloaded and uncompressed, we must first determine exactly what fields from these data records are of interest to us. We are limited by the record structure of the LandView 5 generic data files to 24 data fields per record. The metadata can be of great help here in helping select the fields to actually import into the generic file ("File_01.lv5").

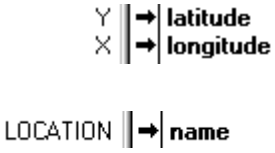
In addition to using the metadata, we can take a detailed look at the data records before actually importing them. We do this by using the import function provided by the LandView 5 software. This functionality allows us to open the file we wish to import and then allows us to "step through" the incoming data field names as well as the actual data records themselves.

Since it is part of a Shapefile format, the data file to be imported is a dBase file structure and is named "quksigx020.dbf." To examine the fields that constitute the records in this file, click on the LandView 5 "File" menu at the top left of your screen and then select the "Import Records" option. Navigate using the "Open File" window to the dBase file ("quksigx020.dbf.") and open it. This will then open another window labeled "Import Field Mapping" with the various field labels from the dBase file in the left pane and the generic field names from the LandView 5 "File_01.lv5" in the right pane.

Selecting the Data

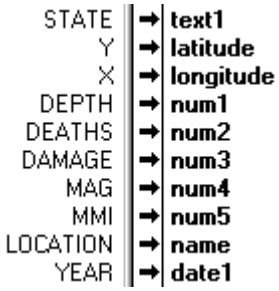
When your cursor is in the right pane, a special icon appears,  allowing you to drag any field name in that pane up or down. By moving these fields up and down, they can be setup to accept the data that will be subsequently imported into "File_01.lv5." To see some of the actual data that will imported, use the "Scan Data" buttons located below

the left pane. For example, clicking once on the right-hand "Scan Data" button will simulate (but not actually perform) the importing of the first record. Doing this reveals that the "X" and "Y" fields are actually the latitude and longitude fields, respectively, from the earthquake record. Therefore, we want to use the special icon and align the "longitude" field with "X" field and the "latitude" field with "Y" field. Once these fields are aligned, click in the center column to change the "dot" to an "arrow" indicating that the import is enabled for these fields. Finally, align the "LOCATION" field from the incoming dBase file with the "name" field of "File_01.lv5." We have now aligned the three fields required by the import operation, as follows:



Once the required "latitude," "longitude," and "name" fields have been aligned with their appropriate imported data fields, we can look to see what other fields might be of interest. Although these additional fields are optional, they often add important informational content to the records ultimately imported into "File_01.lv5." For example, it would probably be useful to include the "STATE" field so as to be able to search for all of the earthquakes in a given state. Likewise, the "DEPTH," "DEATHS," "DAMAGE," "MAG," "MMI," and "YEAR" fields would most likely prove useful. Thus, we should align these additional fields with appropriate fields in "File_01.lv5" depending on the types of data (text, numeric, or date).

We must now align these additional fields with their appropriate fields in "File_01.lv5." The particular order is not critical, but you should make careful note of the exact assignments, as we will need this information in a later step. For the purposes of this example, the following assignments will be made:



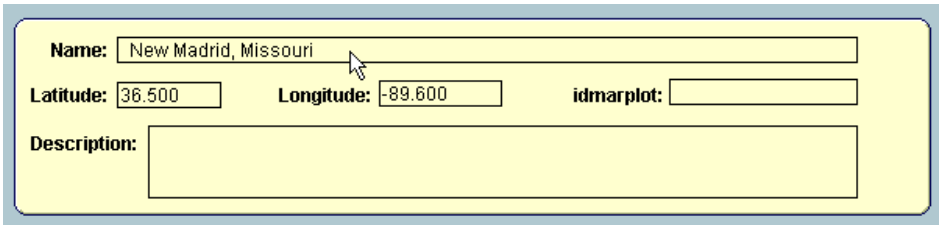
Importing the Data

It is now time to actually import the data. Before doing so, check to see that there are noted only ten "import arrows" turned on, corresponding to the ten fields noted above. If this is the case, click on the "Import" button at the lower right of the window to begin the actual data import operation. After a few seconds, you should see a count of 1,286

records imported into “File_01.lv5,” indicated by the number displayed directly below the “Rolodex” icon on the upper left panel. You can click on the upper and lower portions of this icon to step forwards and backwards through the newly imported records. (Holding down the “Ctrl” key and using the up and down arrows will perform the same navigation).

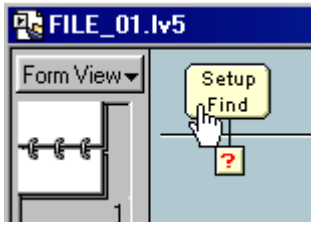
Verifying the Data

As discussed earlier, there are three fields in every record (“latitude,” “longitude,” and “name”) that *must* have values in them in order to be able to create a corresponding map layer. We just imported 1,286 records, and, at first glance, all appears well, as indicated by the fields near the top of the “File_01.lv5” data layout that look like the following:

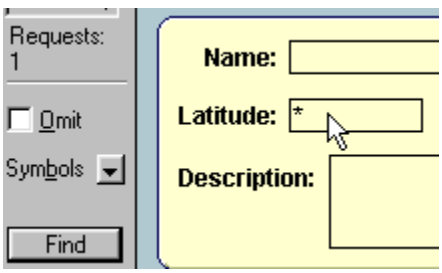


Clicking on the lower half of the Rolodex icon a few times advances through the first several records and every record seems to have a valid “latitude,” “longitude,” and “name” field. However, we must ensure that there are no blank entries in any of these three critical fields anywhere in the file. We could step through the entire file, one record at a time, visually checking these fields, but there is an easier way. Remember that we now have created a fully searchable database file (“File_01.lv5”) into which we just imported 1,286 records. The underlying software for this database is FileMaker Pro, which has a quite flexible set of search and display functions. We will use one of these functions, the “Find,” to locate any blank entries in our three critical fields.

Let’s first examine the “latitude” field. To do this, click on the “Setup Find” button at the top of the data layout, as in the following:



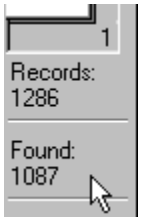
The small, red “question mark” button provides several help screens for setting up a “Find” operation, which you may examine if you’d like. Setting up a “Find” will blank all of the fields on data layout and allow us to select a field to examine. Place your cursor in the field next to the label “Latitude:” and then enter an asterisk (*) in that field so that it appears as follows:



When an asterisk (*) is used in a “Find” operation, the software searches this field in every record in the file for any non-blank values, and then displays the number of records that meet the search criteria. Click on the “Find” button on the gray panel on the left to initiate this search and then notice the resulting count of “Found” records beneath the Rolodex icon. It should appear as follows:

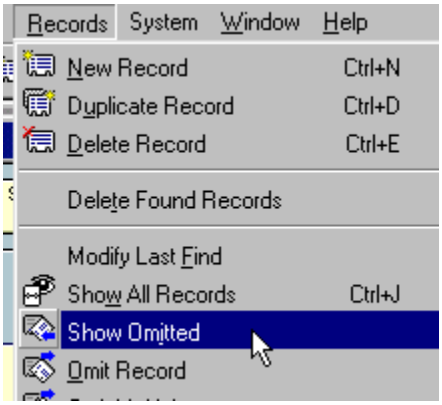
The fact that every one of the 1,286 records was found to have a non-blank “latitude” value means that this field is fine and ready for subsequent processing.

Now, using the same procedure, verify that the “longitude” filed contains no blanks. After searching for asterisks in this field, the count of found records should be identical to that found when searching the “latitude” field. Finally, use the same procedure and search the “name” field for blanks and you should get the following result:

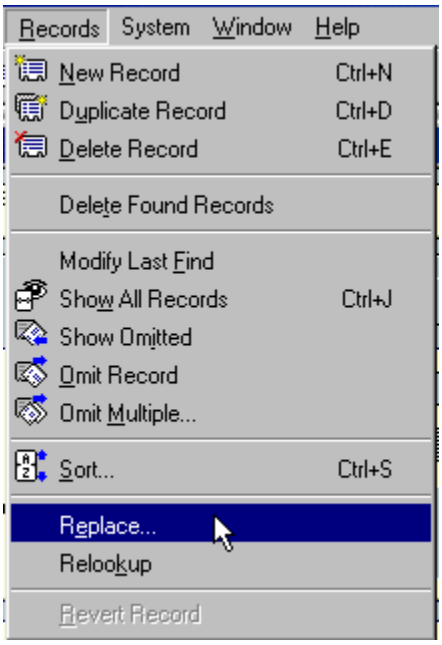


Notice that we only found 1,087 records with non-blank values, meaning there are 199 records with blanks in their “name” field. This will not do, as the map layer that we will be ultimately creating requires a name for every point or object placed in that layer. Thus, we must put some non-blank value in these records. Fortunately, the software provides a convenient way to do this.

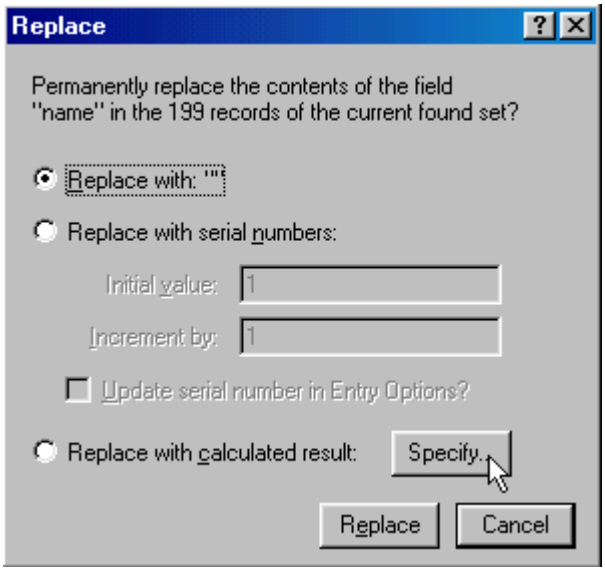
First, we must show the records that contain blank “name” fields. This is done by selecting the “Records” menu followed by the “Show Omitted” option, as follows:



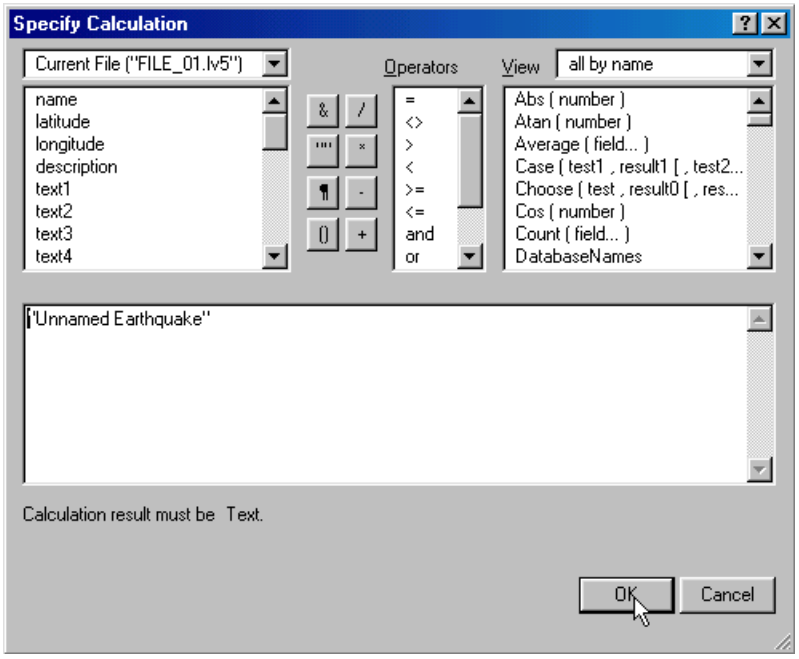
This will then show the 199 records containing the blank “name” fields. To correct this situation, we first click in the “name” field (which currently is blank) and then once again click on the “Records” menu, but this time select the “Replace” option, as follows:



Selecting this option will bring up the “Replace” dialog window where the actual value to be replaced in the 199 records will be entered. Notice that the first radio button in this dialog window is selected, indicating that the field in question (“name”) will be replaced with something that will be specified inside of a pair of quotes. To actually specify that “something,” click on the “Specify” button, as in the following:



This will bring up the “Specify Calculation” dialog window. In the lower white entry box in this window, first type a double quote mark (“) followed by the text “Unnamed Earthquake” and then another double quote mark (“). The window should look like the following just before you click the “OK” button:



After clicking the OK button, the “Replace” dialog window will again appear, at which point a final click on the “Replace” button will tell the software to place the character string “Unnamed Earthquake” in the “name” field of the 199 records currently in the “Found” set. Do this and then step through a few records by use of the Rolodex icon to ensure that that they all now have non-blank values in their “name” fields. Finally, click on the “Show All Records” at the top of the data layout, as in the following:

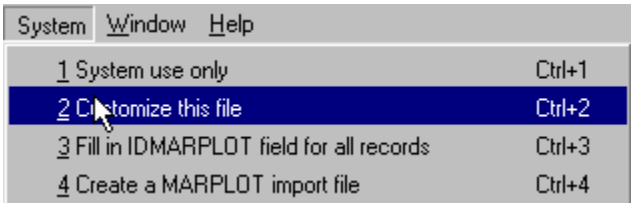
This will once again bring all 1,286 records back into play, including the 199 that we just modified. All records now have a non-blank value in their “name” fields.

Customizing the Data Layout

Notice that there are three groups of “generic” fields in “File_01.lv5” representing text, numeric, and date fields, respectively. There is also a fourth group labeled “check box” for accommodating imported data that is represented by a binary or “yes/no” value. For the moment, we will ignore these “check box” fields.

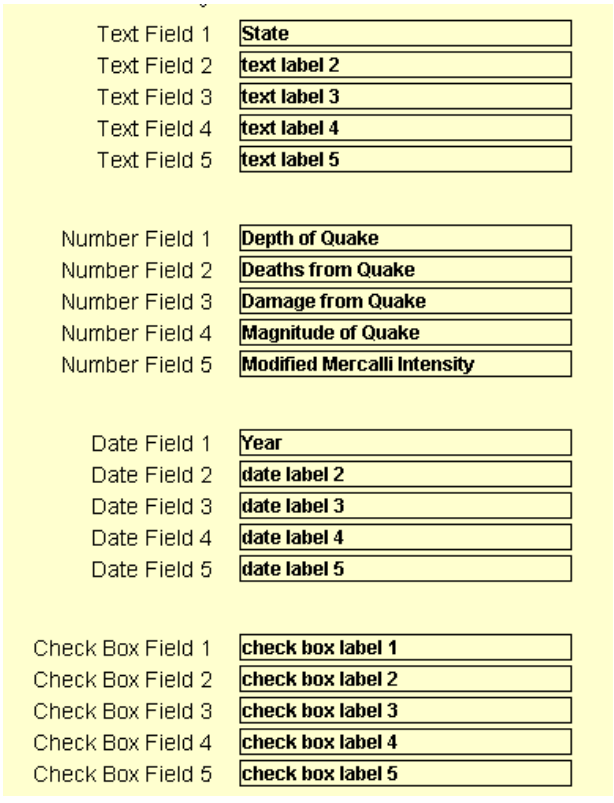
Once the records have been imported into the default data layout for "File_01.lv5," it is time to adjust the default field names ("text label 1," "number label 1," etc.) to reflect the type of data that has actually been imported. For example, "text label 1" should be labeled "State" since this is the type of data it now contains.

To accomplish this, click on the LandView "System" menu and then select the "Customize this file" option, as shown below. This will bring up a display screen where the file and field information for "File_01.lv5" can be changed.



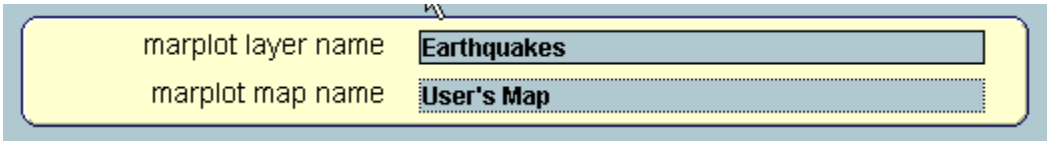
Begin by changing the value in the top filed labeled "File Description" from its default value of "File_01.lv5 Description" to the value "Significant and Historic Earthquakes." Now click on the "Return to User File" button in the top right corner to see the effect of this change, as follows:

Repeat this process, changing each of the appropriate field names so that the results look as shown below. Note that no changes are made to any of the "check box labels," as none of these fields will be used in the import process.



There are two more fields that need to be examined. The first is the "marplot layer name" which reflects the name of the data layer that we are about to create. Change this field to "Earthquakes" and this will be the layer name for all of the earthquake locations we will soon import into MARPLOT.

The second field is the "marplot map name" which defines the folder (named "\USERMAP" on your hard disk) where the map layer information will be saved after it has been imported into MARPLOT. Leave this second field alone, as this is a good place to have MARPLOT save its map information. Now, the fields should look as follows:

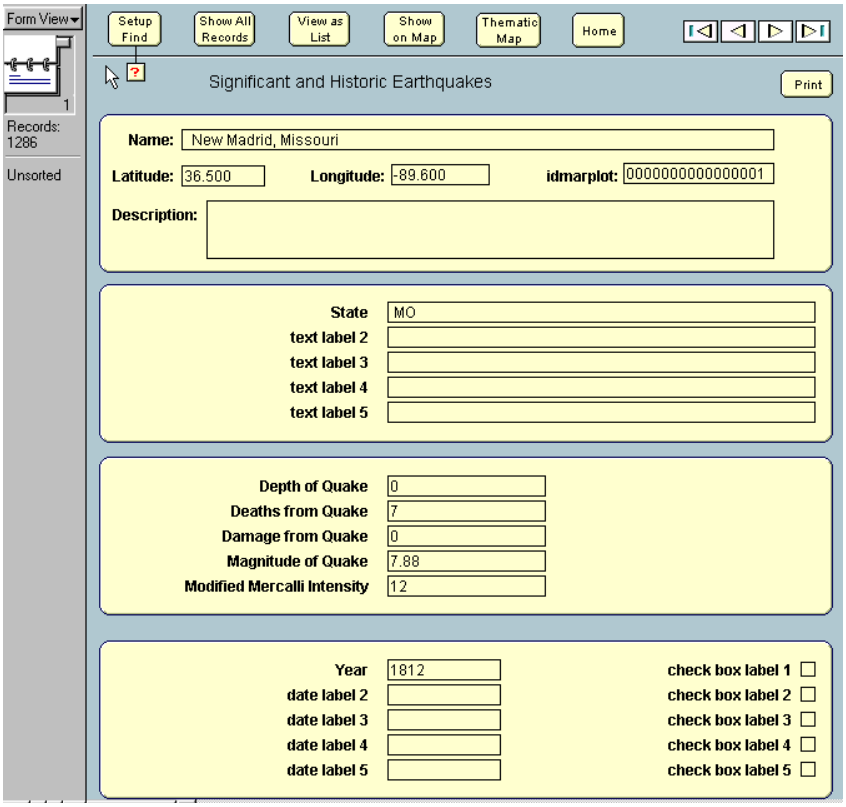


We have now finished all of the field labels for the "File_01.lv5" data layout. Click on the "Return to User File" button at the top right of the screen to see how they look. All of the fields that we have selected to import should now have appropriate field labels.

Populating the MARPLOT link field

LandView 5 consists of two basic processing modules--the database module (developed by EPA) and the mapping module (developed by NOAA). The database module manages the records associated with objects on a map layer, while the mapping module (MARPLOT) actually plots the objects from the map layer. The link field between these two modules is named "idmarplot" and consists of a unique, 16-character alphanumeric field. This link field provides the means by which users can readily switch between the database and mapping modules of LandView 5. But before this can occur, this link field first must be populated with a unique value for every record in the file. Fortunately, this can be accomplished very easily by simply clicking on the "System" menu and then choosing the "Fill in IDMARPLOT field for all records" option, as shown below:

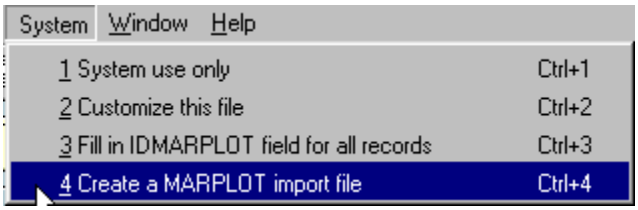
A few seconds after selecting this option you will notice that the "idmarplot" field has been populated with a unique value for every one of the 1,286 records in "File_01.lv5." At this point, the data layout for "File_01.lv5" should appear as follows:



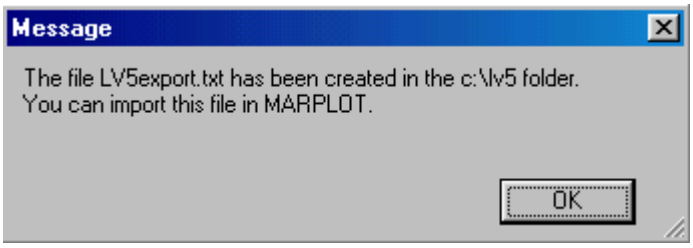
Notice that after populating the MARPLOT link field, the Rolodex icon on the left panel is pointing to the last record in the database (number 1,286) and the data values for this record of an earthquake in New Madrid, Missouri are displayed on the customized data layout.

Creating the MARPLOT import file

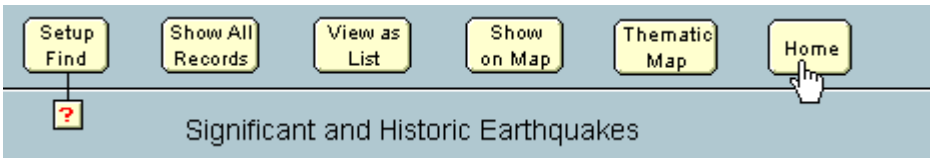
The final step in the process of importing our data representing the significant and historic earthquakes is to create the corresponding map layer for these points. To do this, first click on the "System" menu and then choose the "Create a MARPLOT import file" option, as shown below:



After this option is chosen, the software will use the information specified in the previous steps and create a file named “LV5export.txt” in the lv5 folder, as evidenced by the following message:

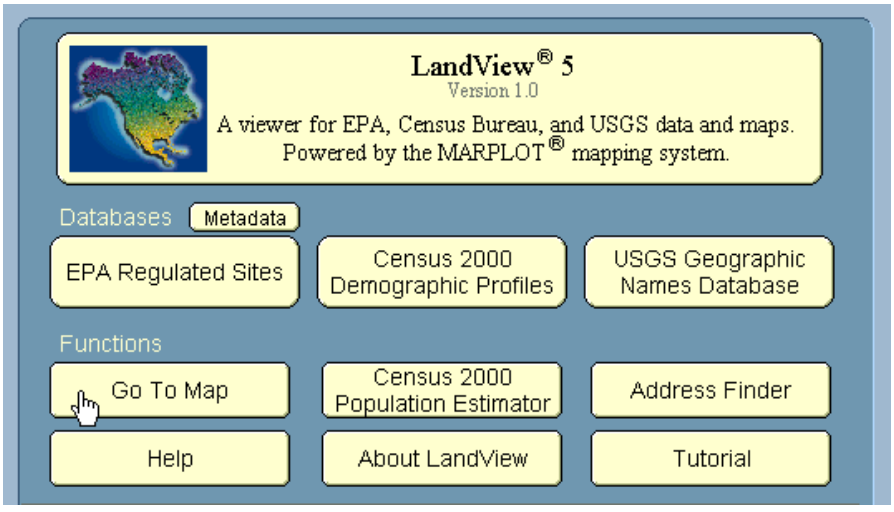


This file must now be imported into MARPLOT to actually create the map layer and store the resulting map information in the folder named “\USERMAP” on the hard disk (MARPLOT compresses this map information into several very compact binary files). To perform this import, the MARPLOT software must be invoked. The easiest way to do this is to first click the “Home” button at the top of the data layout, as follows:

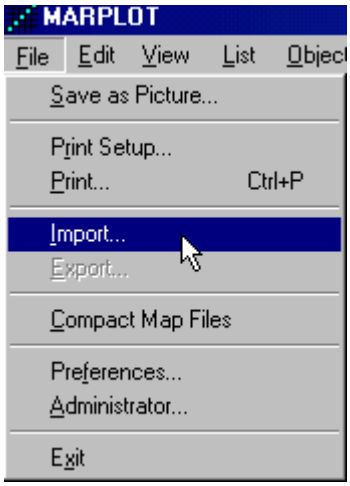


Now click the “Home” button at the top of the “LandView 5 User Files” screen, as follows:

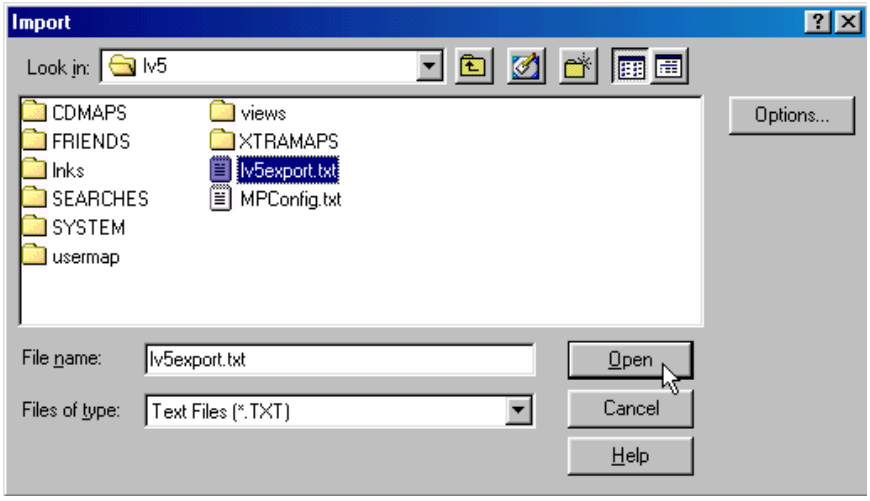
This will return to the LandView 5 “Home” screen where the MARPLOT software can be started by simply clicking on the “Go To Map” button, as in the following:



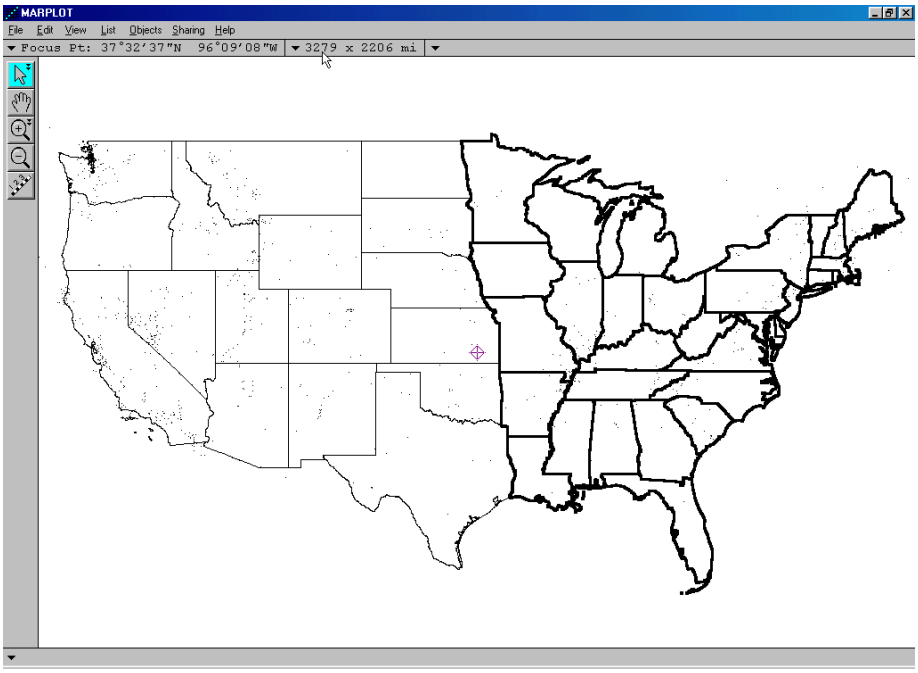
MARPLOT initially displays a map of the U.S., with the state outlines in bold depending on which DVD-ROM disc (East or West) is currently in your drive (this tutorial assumes you are using the East disc). To import the map layer file that we created earlier, simply click on the MARPLOT "File" menu and then select the "Import" option, as in the following:



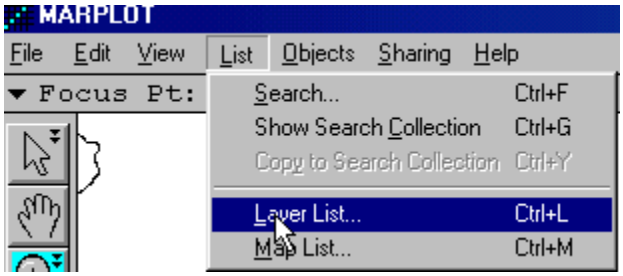
This will bring up the MARPLOT "Import" dialog window. First, select "Text Files (*.TXT)" files from the "Files of type" drop down menu and then navigate to the file named "LV5export.txt" that we just created in the lv5 folder. Select this file and then "Open" it as in the following:



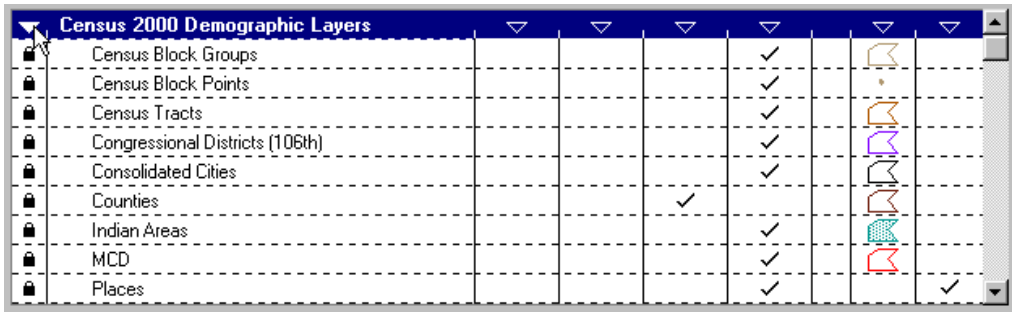
MARPLOT will then proceed to import this file and create a corresponding map layer consisting of 1,286 points, one for every record or earthquake contained in "File_01.lv5." The initial map will look like the following:



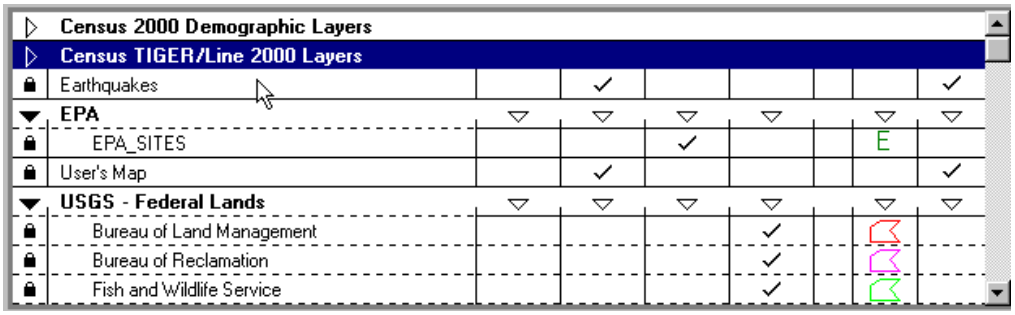
MARPLOT has now imported the imported the file of earthquake locations, created the corresponding map layer, and finally has displayed those locations as small, almost imperceptible points on our map. Let's adjust the map layer and make it easier to see these points. First, click on the MARPLOT "List" menu and then select the "layer List" option, as in the following:



This will bring up the MARPLOT "Layer List" window where all of the various map layer that come with LandView 5 can be seen. The initial view lists all of the "Census 2000 Demographic Layers," one of which (Counties) has a check on the "Range" column. To see other layers, first "collapse" the Demographic Layers by clicking on the down-pointing triangle, as in the following:

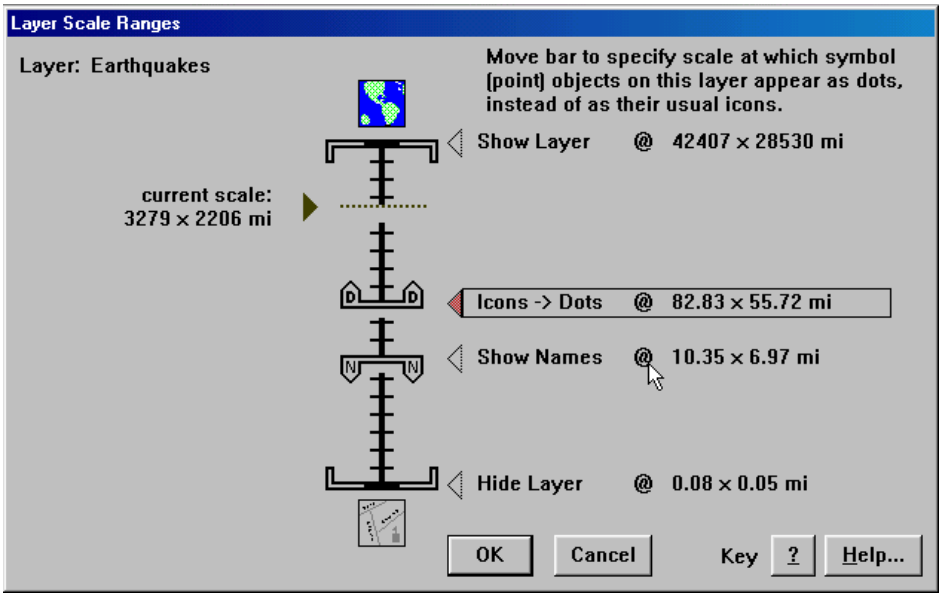


Once these layers are hidden, do the same thing to the “Census TIGER/Line 2000 Layers” and the layer list should then appear like the following:



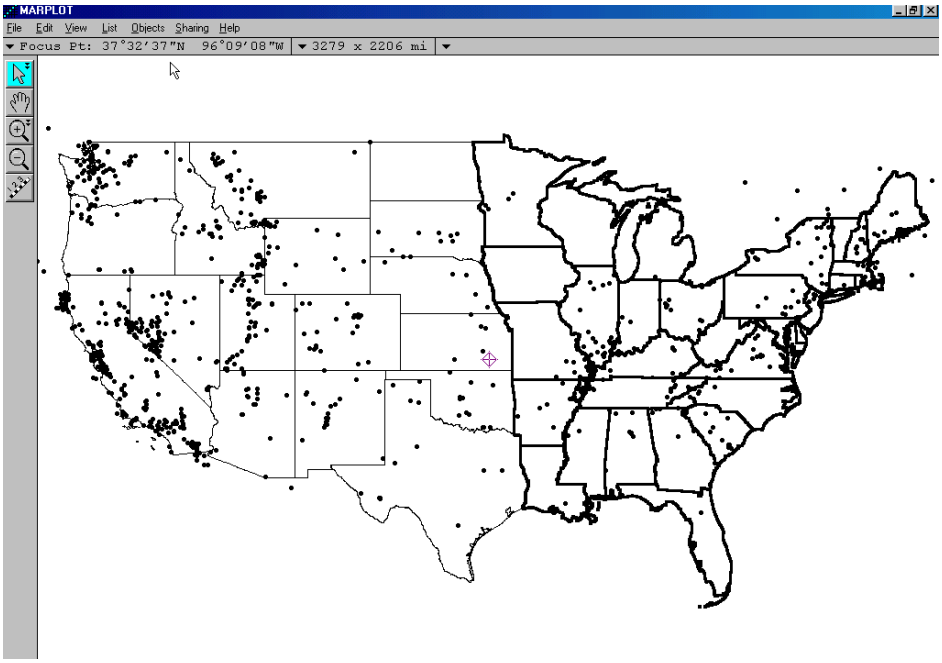
Notice the layer named “Earthquakes” directly below the “Census TIGER/Line 2000 Layers” that we just collapsed. Click on the “Earthquakes” layer and notice in the lower left of the window that we do indeed have 1,286 objects in our map layer.

Now that the Earthquakes layer is highlighted, click on the button labeled “Scale ranges” in the bottom center of the window. This will bring up the “Layer Scale Ranges” dialog window that allows precise control over when a particular map layer. For example, clicking on the bar labeled “Icons -> Dots” allows one to specify the exact scale at which the objects on the layer will switch from larger icons to smaller dots. As it currently appears (see below), whenever the scale is zoomed out anywhere beyond 82.83 x 55.72 miles, the objects will appear as dots.

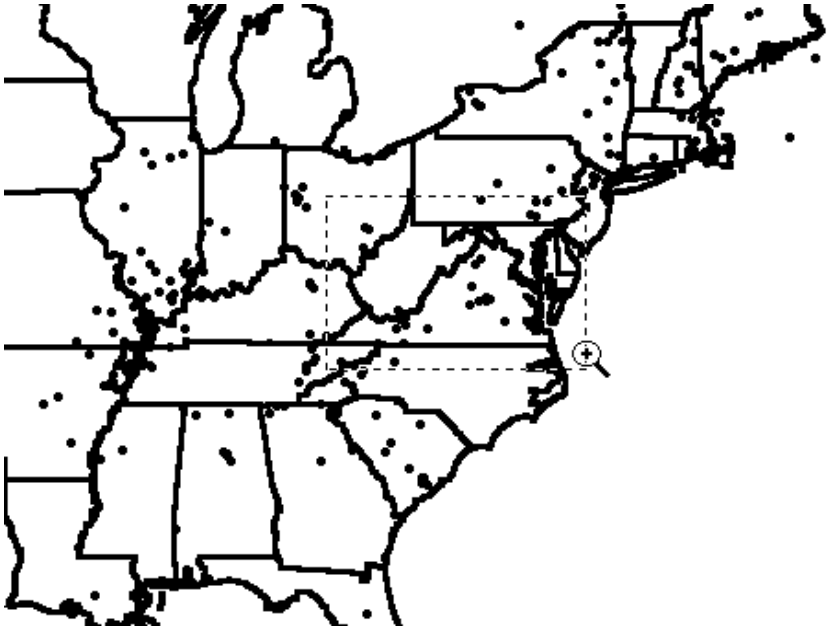


To see the larger icons, simply drag this bar upwards until it is beyond the “current scale” of the map, shown on the left size of the window. Once this bar has been placed

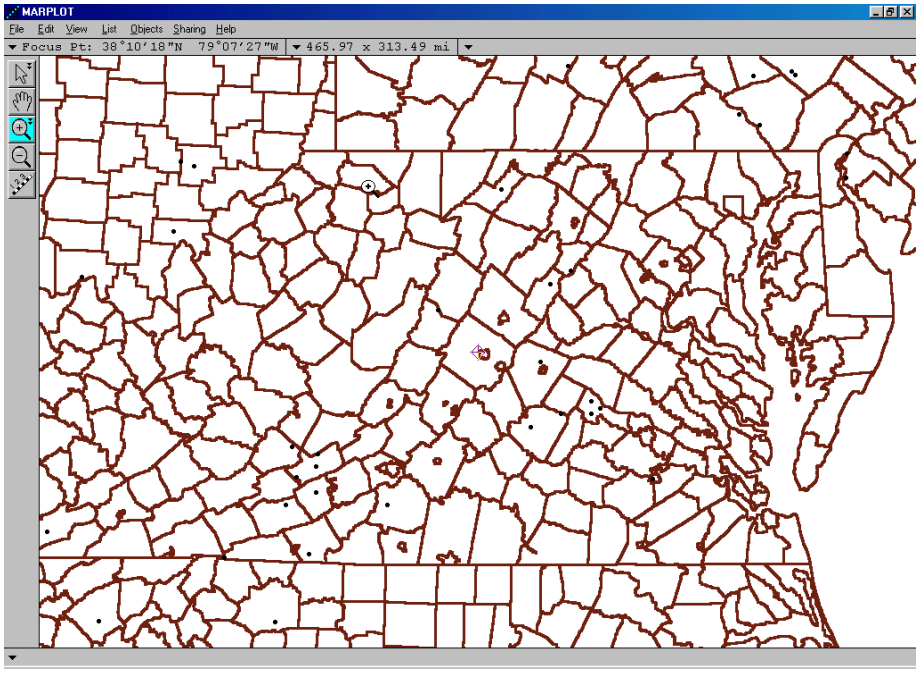
anywhere above this “current scale,” clicking the “OK” button and then another “OK” button on the “Later List” window will produce the following map with more visible icons:



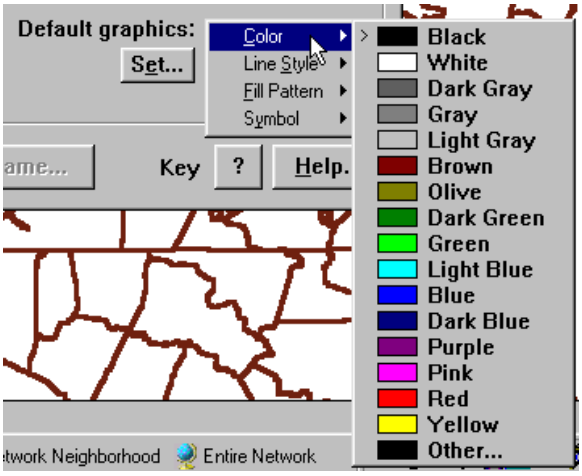
 Let’s focus our attention on the points or earthquake locations within state of Virginia. Click on MARPLOT’s the “Zoom In” tool (shown at left) and drag a rectangle around Virginia, as in the following:



This will “zoom in” on the map and create something like the following:

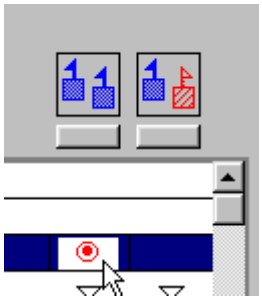


At this point, we can use a few more of the tools in MARPLOT to make those earthquake locations even more distinct. To do this, again click on the MARPLOT "List" menu and then select the "layer List" option, as before. Now click on the "Set…" button below the "Default graphics:" label on the lower right. From the popup list, select the "Color" option and then choose red as the color for the objects, as follows:

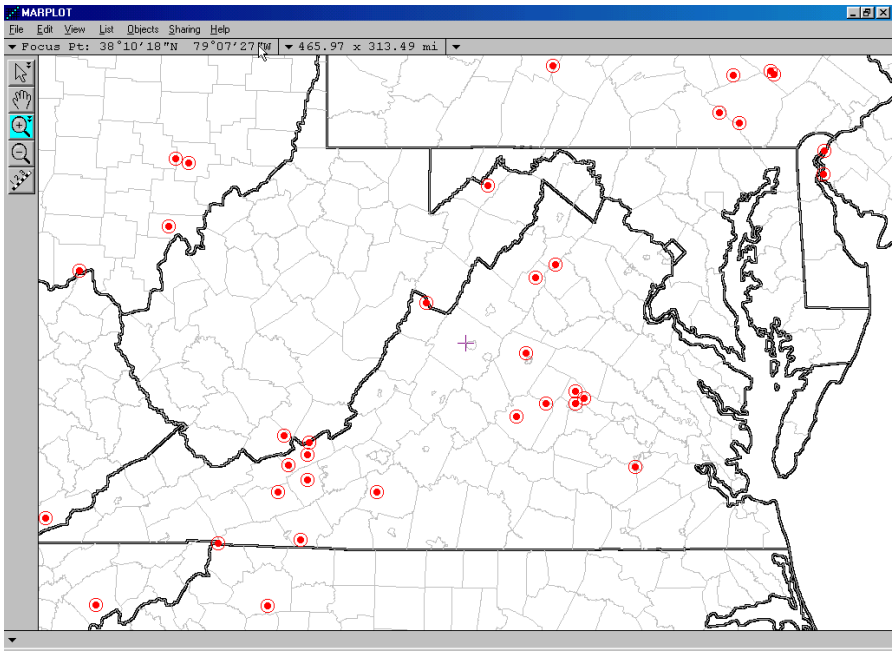


Click the "Set…" button again and this time select the "Symbol" option that looks like a solid dot with a circle located in the upper right section of the symbol list, as follows:

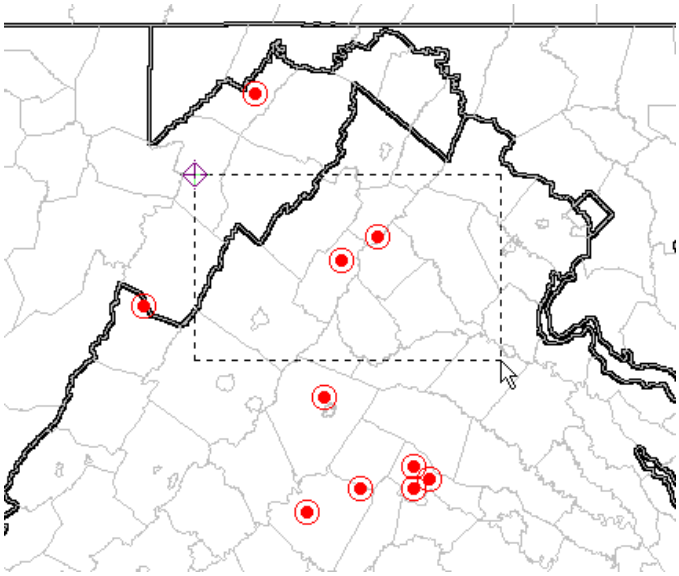
Finally, to actually make these changes take effect, we must click in the column under the two blue flags which tells MARPLOT to use the graphical settings that we have just changed in the pop-up box, as follows:



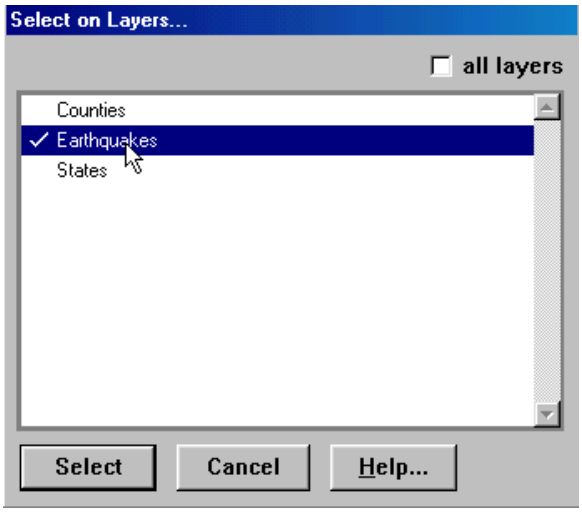
Before closing the “Layer List” window, click on the right-pointing triangle next to the collapsed “Census 2000 Demographic Layers” and then highlight the “Counties” layer. In a manner similar to before, set the “Default graphics” on the “Counties” layer so that the “color” is light gray and the “Line Style” is a very thin line. Finally, click on the “OK” button at the bottom left and the following map should appear:



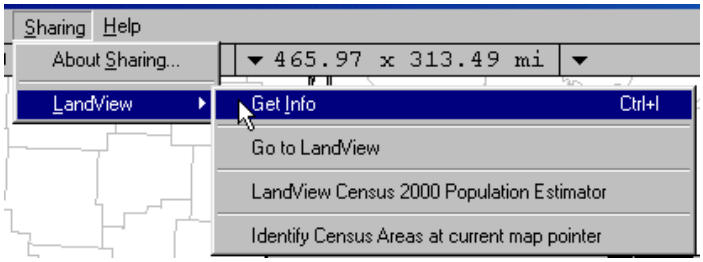
The points on the map represent earthquakes and can be individually examined by clicking on them with the object pointer (shown at left) located at the top of the far left gray panel. When an object is selected, its "name" is displayed at the lower left of the map display window. If you wish to examine the actual data record associated with a given point or points, simply use the same object pointer, but this time drag a rectangle around the points of interest. For example, if we wanted to examine the two points in the northern part of Virginia, we would drag a rectangle around them, as follows:



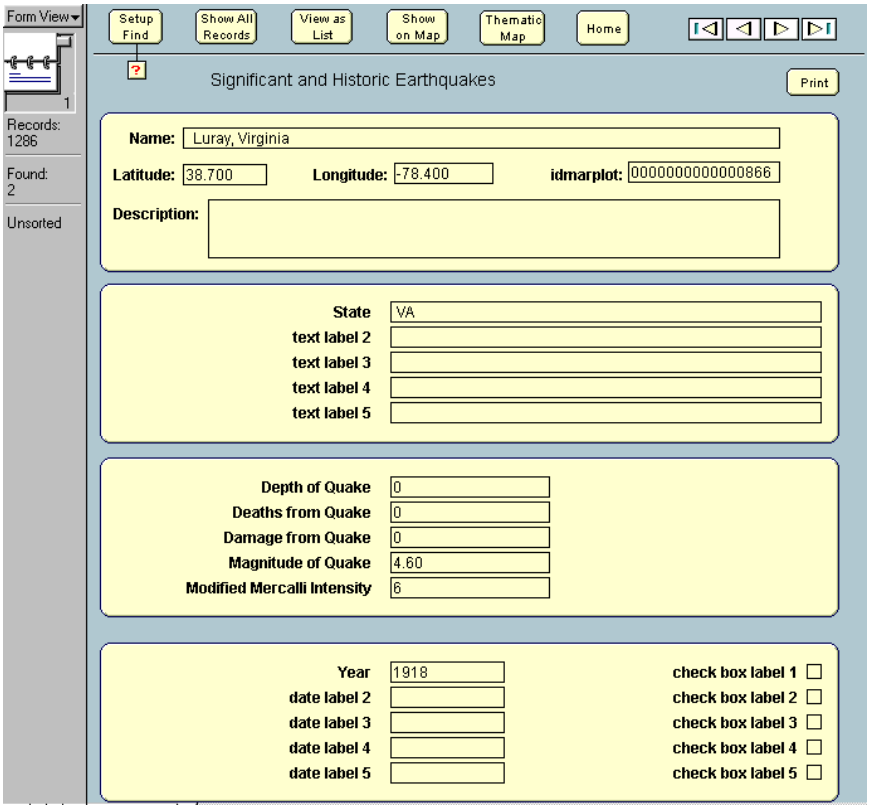
Then, MARPLOT displays a "Select on Layers" window where the "Earthquakes" layer would be first highlighted and then selected by clicking on the "Select" button at the bottom left, as follows:



Once this was done, the two selected points would each be surrounded by four red squares, which is MARPLOT's method of indicating selected objects. Then, to actually select the two database records corresponding to these two map objects, you would first click the MARPLOT "Sharing" menu followed by selecting the "LandView" and "Get Info" combination, as in the following:



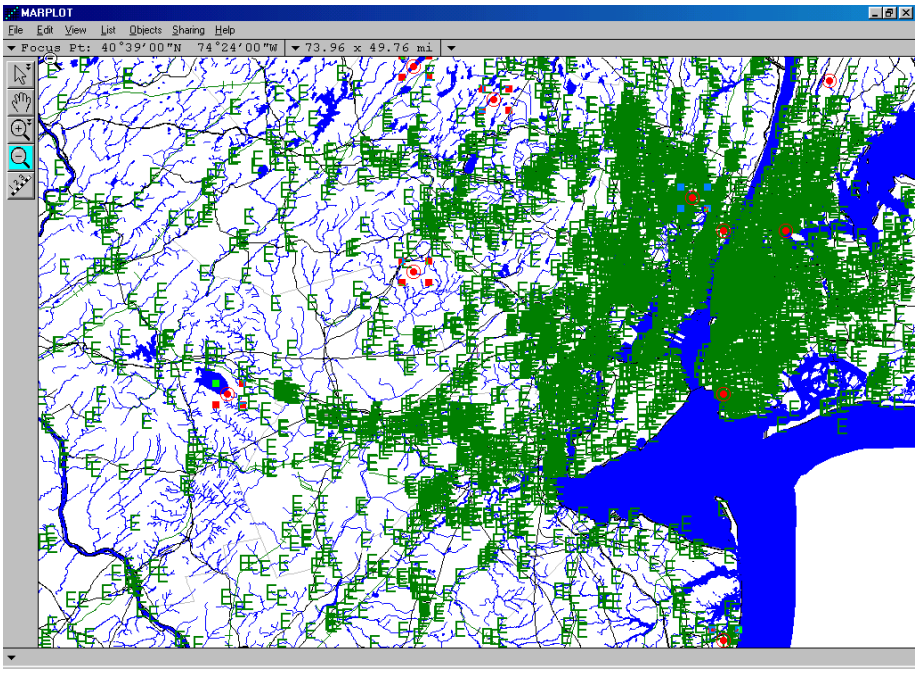
MARPLOT now passes control to the database module and within seconds, the records corresponding to the two selected points are displayed and look like the following:



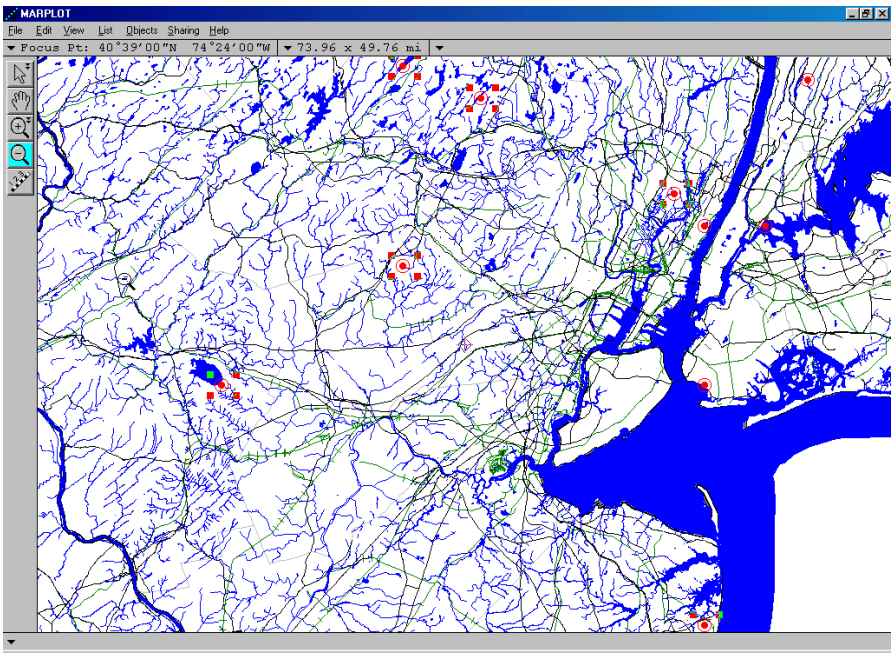
We can see from the display of the first record that this earthquake occurred in 1918 with a magnitude of 4.6. This ability of linking between the map objects and the corresponding data records is very powerful. It also is bi-directional in that we could just as easily perform a search of the database records and then plot the results. For example, if we wanted to plot all of the earthquakes that have ever occurred in the state of New Jersey,

you would first click the “Setup Find” button, enter the value of “NJ” in the first field of the data groups, and then click on the “Find” button. After doing this, you would discover that New Jersey has had six recorded earthquakes over the years, one in 1783 as large as 5.3 on the Richter scale! The “View as List” button would display these records in a tabular form.

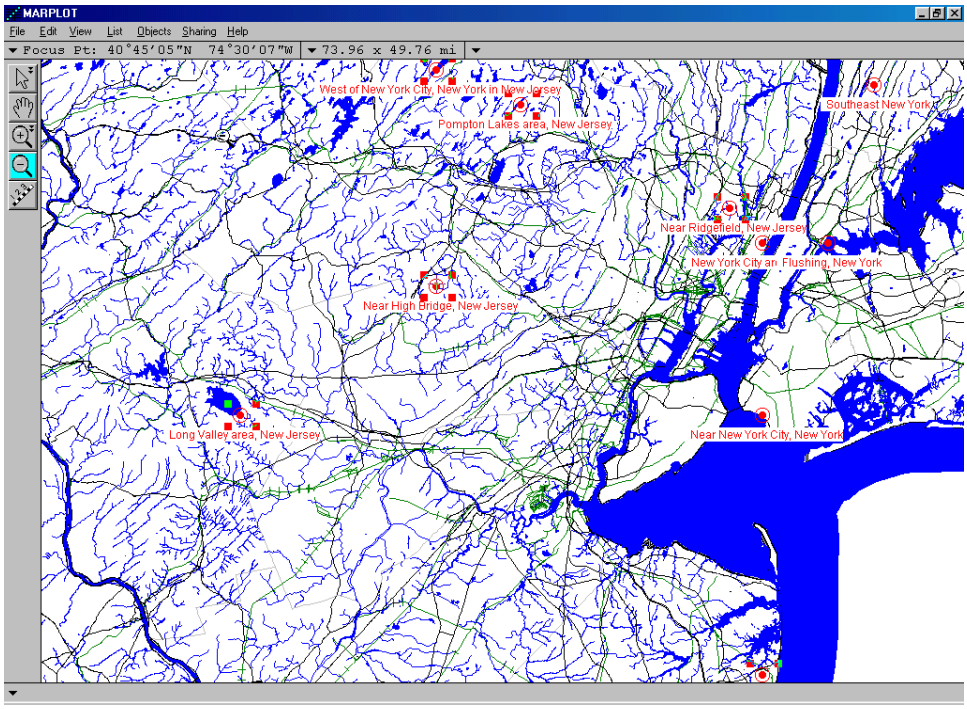
To plot these six points on our map, simply click on the “Show in Map” button and, accepting the parameters on the “Show on Map” dialog screen, the following display will appear, automatically scaled to display all six of the data points of interest:



The map, however, appears a bit cluttered because of all the EPA sites that have come on because of the map scale. To make this map a bit easier to understand, go into MARPLOT’s Layer List and “hide” the EPA layer of map objects. After doing this, the map becomes much easier to read and locate the earthquake points, as follows:



Also notice that because we are zoomed somewhat far in, several other map layers have come on, including bodies of water and railroads. One last adjustment might be useful, and that is to turn on the names of the displayed earthquake locations. To do this, return once more to MARPLOT's Layer List, locate the "Earthquakes" map layer, and then click o=in the "Show + Names" column to produce the following map:



You have now successfully imported a layer of point data into LandView 5. You have created a table containing the data records and have created a corresponding map layer containing objects for every record in the database. You have then manipulated these map objects and retrieved their corresponding data records. Congratulations!